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**GORDON RESEARCH CONFERENCES** *frontiers of science*

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**Nancy Ryan Gray, Ph.D.**  
Director

**2010 GORDON RESEARCH CONFERENCE  
on RADIATION CHEMISTRY**

**FINAL PROGRESS REPORT**

DEPARTMENT OF ENERGY  
GRANT NO. DE-SC0004936

The Gordon Research Conference on **RADIATION CHEMISTRY** was held at Proctor Academy, Andover, New Hampshire, July 18-23, 2010. The Conference was well-attended with 100 participants (attendees list attached). The attendees represented the spectrum of endeavor in this field coming from academia, industry, and government laboratories, both U.S. and foreign scientists, senior researchers, young investigators, and students. Of the 100 attendees, 36 voluntarily responded to a general inquiry regarding ethnicity which appears on our registration forms. Of the 36 respondents, 12% were Minorities – 3% Hispanic, 6% Asian and 3% African American. Approximately 30% of the participants at the 2010 meeting were women.

In designing the formal speakers program, emphasis was placed on current unpublished research and discussion of the future target areas in this field. There was a conscious effort to stimulate lively discussion about the key issues in the field today. Time for formal presentations was limited in the interest of group discussions. In order that more scientists could communicate their most recent results, poster presentation time was scheduled. Attached is a copy of the formal schedule and speaker program and the poster program. In addition to these formal interactions, "free time" was scheduled to allow informal discussions. Such discussions are fostering new collaborations and joint efforts in the field.

Thank you for your support of this Conference. As you know, in the interest of promoting the presentation of unpublished and frontier-breaking research, Gordon Research Conferences does not permit publication of meeting proceedings. If you wish any further details, please feel free to contact me. Thank you.

Sincerely,  
*Thomas Orlando, Conference Chairperson*  
GEORGIA INSTITUTE OF TECHNOLOGY

## **In Vivo Magnetic Resonance**

Radiation Driven Processes in Physics, Chemistry and Biology

July 18-23, 2010

Proctor Academy

Andover, NH

Chair:

**Thomas M. Orlando**

Vice Chair:

**William A. Bernhard**

The 2010 Gordon Conference on Radiation Chemistry will present cutting edge research regarding the study of radiation-induced chemical transformations. Radiation Chemistry or "high energy" chemistry is primarily initiated by ionizing radiation: i.e. photons or particles with energy sufficient to create conduction band electrons and "holes", excitons, ionic and neutral free radicals, highly excited states, and solvated electrons. These transients often interact or "react" to form products vastly different than those produced under thermal equilibrium conditions. The non-equilibrium, non-thermal conditions driving radiation chemistry exist in plasmas, star-forming regions, the outer solar system, nuclear reactors, nuclear waste repositories, radiation-based medical/clinical treatment centers and in radiation/materials processing facilities. The 2010 conference has a strong interdisciplinary flavor with focus areas spanning i) the fundamental physics and chemistry involved in ultrafast (atto/femtosecond) energy deposition events, ii) radiation-induced processes in biology (particularly spatially resolved studies), iii) radiation-induced modification of materials at the nanoscale and cosmic ray/x-ray mediated processes in planetary science/astrochemistry. While the conference concentrates on fundamental science, topical applied areas covered will also include nuclear power, materials/polymer processing, and clinical/radiation treatment in medicine. The Conference will bring together investigators at the forefront of their field, and will provide opportunities for junior scientists and graduate students to present work in poster format or as contributors to the Young Investigator session. The program and format provides excellent avenues to promote cross-disciplinary collaborations.

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### **SUNDAY**

2:00 pm - 9:00 pm	Arrival and Check-in (Office Closed 6:00 pm - 7:00 pm)
6:00 pm	Dinner
7:30 pm - 7:40 pm	Welcome / Introductory Comments by GRC Site Staff
7:40 pm - 9:30 pm	<b>NEW ADVANCES IN ULTRAFAST RADIATION STUDIES</b>
7:40 pm - 7:45 pm	Discussion Leader: <b>Ian Carmichael</b> (Univ. of Notre Dame, Radiation Lab)
7:45 pm - 8:25 pm	<b>Margaret Murnane</b> (JILA/University of Colorado) "Attosecond processes using short wavelength lasers"
8:25 pm - 8:40 pm	Discussion
8:40 pm - 9:15 pm	<b>James Wishart</b> (Brookhaven National Laboratory)

"Evolving detection methods at LEAF and what they show about early events in ionic liquid radiolysis"

9:15 pm - 9:30 pm Discussion

## MONDAY

7:30 am - 8:30 am Breakfast

8:30 am Group Photo

9:00 am - 12:30 pm **ULTRAFAST PROCESSES IN WATER**

9:00 am - 9:05 am Discussion Leader: **Dan Chipman** (Univ. of Notre Dame, Radiation Lab)

9:05 am - 9:45 am **Thomas Rescigno** (Lawrence Livermore National Laboratory)  
"Dissociative Electron Attachment in Water: A Theoretical Description"

9:45 am - 10:00 am Discussion

10:00 am - 10:35 am Coffee Break

10:35 am - 11:15 am **Ali Belkacem** (Lawrence Berkeley National Laboratory)  
"A full angle- and energy-resolved measurement of dissociative electron attachment of water"

11:15 am - 11:30 am Discussion

11:30 am - 12:10 pm **Simon Pimblott** (University of Manchester, United Kingdom)  
"Monte Carlo simulations of ultrafast processes during radiolysis"

12:10 pm - 12:25 pm Discussion

12:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm Poster Session I

6:00 pm Dinner

7:30 pm - 9:30 pm **LOW-ENERGY ELECTRONS AND BIOMOLECULES**

7:30 pm - 7:35 pm Discussion Leader: **Michael Sevilla** (Univ. of Oakland)

7:35 pm - 8:15 pm **Darel Hunting** (Univ. of Sherbrooke)  
"DNA damage by low energy electrons: What we have learned and what we wish to know"

8:15 pm - 8:30 pm Discussion

8:30 pm - 9:10 pm **Qing-Bin Lu** (Univ. of Waterloo)  
"DNA damage induced by dissociative electron transfer of ultrashort-lived, weakly-bound prehydrated electrons: Implications for cancer radiotherapy"

9:10 pm - 9:25 pm Discussion

## TUESDAY

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **DNA DAMAGE**

9:00 am - 9:05 am Discussion Leader: **J. Milligan** (Univ. of California, San Diego)

9:05 am - 9:40 am **Amanda Friedrich-Bryant** (Univ. of Toledo)

	"Generation of deoxyribose radicals by low energy electrons"
9:40 am - 9:50 am	Discussion
9:50 am - 10:25 am	<b>Robert Anderson</b> (Univ. of Auckland, New Zealand) "Hole migration in DNA: the role of GC"
10:20 am - 10:35 am	Discussion
10:35 am - 10:50 am	Coffee Break
10:50 am - 12:30 pm	<b>CELLULAR RESPONSE</b>
10:50 am - 11:30 am	<b>Kevin Prire</b> (Queens University, Belfast) "Application of micro-beams to understanding cellular response"
11:30 am - 11:40 am	Discussion
11:40 am - 12:20 pm	<b>Kathryn Held</b> (Massachusetts Gen. Hospital) "Radiation chemistry initiates the bystander effects"
12:20 pm - 12:30 pm	Discussion
12:30 pm	Lunch
1:30 pm - 4:00 pm	Free Time
4:00 pm - 6:00 pm	Poster Session 2
6:00 pm	Dinner
7:30 pm - 9:30 pm	<b>YOUNG INVESTIGATOR SESSION</b>
	Discussion Leader: <b>William Bernhard</b> (University of Rochester)
7:30 pm - 7:45 pm	<b>Julia Stähler</b> (Fritz-Haber-Institut der Max-Planck-Gesellschaft) "Ultrafast electron transfer across polar molecule-metal interfaces: strong coupling vs. molecular screening"
7:45 pm - 7:50 pm	Discussion
7:50 pm - 8:05 pm	<b>Laurent Bernau</b> (Swiss Federal Labs for Materials Research & Technology) "Electron-impact dissociation of $\text{Co}_2(\text{CO})_8$ : Direct nano-scale patterning of high-sensitivity magnetic material using focused electrons beams"
8:05 pm - 8:10 pm	Discussion
8:10 pm - 8:25 pm	<b>Ondrej Marsálek</b> (IOCB, The Academy of Sciences of the Czech Republic) "Localization and Reactivity of the Hydrated Electron"
8:25 pm - 8:30 pm	Discussion
8:30 pm - 8:45 pm	<b>Erika Procel</b> (Université Paris Sud) "The use of nanoparticles as auger emitters for improvement of cancer treatments"
8:45 pm - 8:50 pm	Discussion
8:50 pm - 9:05 pm	<b>Susan Howett</b> (University of Western Ontario) "Aqueous-Ionic Liquid Interfacial Reactions and Transport under $\gamma$ -Irradiation"

- 9:05 pm - 9:10 pm Discussion
- 9:10 pm - 9:25 pm **Ross Larsen** (University of California at Los Angeles)  
"Does the hydrated electron occupy a cavity?"
- 9:25 pm - 9:30 pm Discussion

## WEDNESDAY

- 7:30 am - 8:30 am Breakfast
- 9:00 am - 12:30 pm **RADIATION EFFECTS IN ASTROCHEMISTRY AND ASTROBIOLOGY**
- 9:00 am - 9:05 am Discussion Leader: **Perry Gerakines** (Univ. of Alabama)
- 9:05 am - 9:40 am **Karin Oberg** (Harvard-Smithsonian Center for Astrophysics)  
"Nonthermal production of complex prebiotic molecules in the astrophysical environment"
- 9:40 am - 9:50 am Discussion
- 9:50 am - 10:25 am **Richard Rosenberg** (Argonne National Laboratory)  
"Chiral-selective chemistry induced by spin-polarized electrons"
- 10:25 am - 10:35 am Discussion
- 10:35 am - 10:50 am Coffee Break
- 10:50 am - 11:30 am **Raul Baragiola** (Univ. of Virginia)  
"Ion-beam irradiation studies on minerals and icy bodies"
- 11:30 am - 11:40 am Discussion
- 11:40 am - 12:20 pm **Robert Carlson** (Jet Propulsion Laboratory)  
"Radiation Chemistry in the Solar System and Beyond"
- 12:20 pm - 12:30 pm Discussion
- 12:30 pm Lunch
- 1:30 pm - 4:00 pm Free Time
- 4:00 pm - 6:00 pm Poster Session 3
- 6:00 pm Dinner
- 7:00 pm - 7:30 pm Business Meeting  
(Nominations for the next Vice Chair; Fill out Conference Evaluation Forms; Discuss future Site & Scheduling preferences; Election of the next Vice Chair)
- 7:30 pm - 9:30 pm **POLYMERS AND INTERFACIAL ENERGY TRANSFER**
- 7:30 pm - 7:35 pm Discussion Leader: **Mehran Mostafavi** (University of Paris-Sud)
- 7:35 pm - 8:20 pm **Greg. A. Kimmel** (Pacific Northwest National Laboratory)  
"Probing interfacial energy exchange and non-thermal reactions on water covered surfaces using low-energy electron beams"
- 8:20 pm - 8:35 pm Discussion

8:35 pm - 9:15 pm **Laurens Siebbeles** (Delft University of Technology)  
"Interfacial charge generation in polymer/fullerene /quantum dot blend films"

9:15 pm - 9:30 pm Discussion

## THURSDAY

7:30 am - 8:30 am Breakfast

9:00 am - 12:30 pm **NANOSCALE PATTERNING USING RADIATION**

9:00 am - 9:05 am Discussion Leader: **Jay LaVerne** (Notre Dame Univ. Radiation Lab)

9:05 am - 9:45 am **C. W. Hagen** (Delft Univ.)  
"Electron-beam induced formation of nanostructures"

9:45 am - 10:00 am Discussion

10:00 am Coffee Break

10:30 am - 11:15 am **Kathy Dunn** (SUNY-Albany)  
"Electron-beam induced nanostructure patterning at cryogenic temperatures"

11:15 am - 11:30 am Discussion

11:30 am - 12:15 pm **Seiichi Tagawa** (Osaka Univ.)  
"Advances in EUV lithography"

12:15 pm - 12:30 pm Discussion

12:30 pm Lunch

1:30 pm - 4:00 pm Free Time

4:00 pm - 6:00 pm Poster Session 4

6:00 pm Dinner

7:30 pm - 9:30 pm **NUCLEAR WASTE AND REACTOR RADIATION CHEMISTRY**

7:30 pm - 7:35 pm Discussion Leader: **Mohamad Al-Sheikhly** (Univ. of Maryland)

7:35 pm - 8:15 pm **Barbara Pastina** (Saanio & Rieckola, Finland)  
"Short and long term radiation chemistry challenges in spent fuel management"

8:15 pm - 8:30 pm Discussion

8:30 pm - 9:15 pm **David Bartels** (Notre Dame Radiation Laboratory)  
"Radiation-induced reactions in water at high temperature and pressure"

9:15 pm - 9:30 pm Discussion

## FRIDAY

7:30 am - 8:30 am Breakfast

9:00 am Depart

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Funding for this conference was made possible (in part) by (Grant Award #1 R13 CA153308-01) from the National Cancer Institute. The views expressed in written conference materials or publications and by speakers and moderators do not necessarily reflect the official policies of the Department of Health and Human Services; nor does mention by trade names, commercial practices, or organizations imply endorsement by the U.S. Government.

## Radiation Chemistry (2010)

Name	Organization	Participation	Status
ABDALLAH, BUTHINA	UNIVERSITY OF TOLEDO	Poster Presenter	Registered
AL-SHEIKLY, MOHAMAD	UNIVERSITY OF MARYLAND	Discussion Leader	Registered
ANDERSON, ROBERT F	UNIVERSITY OF AUCKLAND	Speaker	Registered
BAIDAK, ALIAKSANDR	NOTRE DAME RADIATION LABORATORY	Poster Presenter	Registered
BALCERZYK, ANNA	LE LABORATOIRE DE CHIMIE PHYSIQUE (LCP) -CNRS	Poster Presenter	Registered
BARAGIOLA, RAUL A	UNIVERSITY OF VIRGINIA	Speaker	Registered
BARTELS, DAVID M	NOTRE DAME UNIVERSITY	Speaker	Registered
BELKACEM, ALI	LAWRENCE BERKELEY NATIONAL LABORATORY	Speaker	Registered
BENNETT, CHRISTOPHER J	UNIVERSITY OF HAWAII' I AT MANOA	Poster Presenter	Registered
BERA, PARTHA P	NASA AMES RESEARCH CENTER	Poster Presenter	Registered
BEREJKA, ANTHONY J	IONICORP	Poster Presenter	Registered
BERNAU, LAURENT	EMPA SWISS FED. LAB. FOR MATERIALS RESEARCH	Speaker	Registered
BERNHARD, WILLIAM A	UNIVERSITY OF ROCHESTER	Vice Chair	Registered
BLACK, PAUL J	UNIVERSITY OF ROCHESTER	Poster Presenter	Registered
BREEN, KRISTIN J	YALE UNIVERSITY	Poster Presenter	Registered
BRESIN, MATTHEW D	COLLEGE OF NANOSCALE SCIENCE & ENGINEERING	Attendee	Registered
BROWN, ASHLEY R	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
BRYANT-FRIEDRICH, AMANDA	UNIVERSITY OF TOLEDO	Speaker	Registered
CABRAL DO COUTO, PAULO R	UNIVERSITY OF NOTRE DAME	Poster Presenter	Registered
CARLSON, ROBERT W	JET PROPULSION LABORATORY 183-601	Speaker	Registered
CARMICHAEL, IAN	UNIVERSITY OF NOTRE DAME	Discussion Leader	Registered
CHIPMAN, DANIEL M	NOTRE DAME RADIATION LABORATORY	Discussion Leader	Registered
CLOSE, DAVID M	EAST TENNESSEE STATE UNIVERSITY	Attendee	Registered
CROWELL, ROBERT A	BROOKHAVEN NATIONAL LABORATORY	Attendee	Registered
DAWLEY, MARGARET M	GEORGIA INSTITUTE OF TECHNOLOGY	Poster Presenter	Registered
DUNN, KATHLEEN A	UNIVERSITY AT ALBANY - SUNY	Speaker	Registered
FELIGA, RAFAL	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
GERAKINES, PERRY A	UNIVERSITY OF ALABAMA AT BIRMINGHAM	Discussion Leader	Registered
GHOSH, DEBASHREE	UNIVERSITY OF SOUTHERN CALIFORNIA	Poster Presenter	Registered
GOHDO, MASAO	BROOKHAVEN NATIONAL LABORATORY	Attendee	Registered
HAGEN, CORNELIS W	DELFT UNIVERSITY OF TECHNOLOGY	Speaker	Registered
HAXTON, DANIEL J	LAWRENCE BERKELEY NATIONAL LAB	Poster Presenter	Registered
HEALY, ANDREW T	UNIVERSITY OF MINNESOTA	Attendee	Registered
HELD, KATHRYN D	MASSACHUSETTS GENERAL HOSPITAL	Speaker	Registered
HIEJIMA, YUSUKE	UNIVERSITY OF NOTRE DAME	Poster Presenter	Registered
HOUEE-LEVIN, CHANTAL	UNIVERSITÉ PARIS SUD	Poster Presenter	Registered
HOWETT, SUSAN	UNIVERSITY OF WESTERN ONTARIO	Speaker	Registered
HUERTA PARAJON, MONICA	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
HUNTING, DAREL	UNIVERSITY DE SHERBROOKE	Speaker	Registered
JANIK, IRENEUSZ	UNIVERSITY OF NOTRE DAME	Poster Presenter	Registered
JONAH, CHARLES D	ARGONNE NATIONAL LABORATORY	Attendee	Registered



JONSSON, MATS	ROYAL INSTITUTE OF TECHNOLOGY	Attendee	Registered
JOSEPH, JIJU M	UNIVERSITY OF WESTERN ONTARIO	Poster Presenter	Registered
KALYANARAMAN, VIJAYALAKSHMI	ARGONNE NATIONAL LABORATORY	Poster Presenter	Registered
KANJANA, KOTCHAPHAN	NOTRE DAME UNIVERSITY	Poster Presenter	Registered
KESZENMAN, DEBORAH	BROOKHAVEN NATIONAL LABORATORY	Poster Presenter	Registered
KIMMEL, GREGORY A	PACIFIC NORTHWEST NATIONAL LABORATORY	Discussion Leader	Registered
KOEHLER, SVEN P K	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
KORNACKA, EWA MARIA	INSTITUTE OF NUCLEAR CHEMISTRY & TECHNOLOGY	Poster Presenter	Registered
KUMAGAI, YUTA	JAPAN ATOMIC ENERGY AGENCY	Poster Presenter	Registered
KUMAR, ANIL	OAKLAND UNIVERSITY	Poster Presenter	Registered
LARSEN, ROSS E	NATIONAL RENEWABLE ENERGY LABORATORY	Speaker	Registered
LAVERNE, JAY A	UNIVERSITY OF NOTRE DAME	Discussion Leader	Registered
LEE, ALBERT	UNIVERSITY OF TEXAS, AUSTIN	Attendee	Registered
LU, QING-BIN	UNIVERSITY OF WATERLOO	Speaker	Registered
MARIN, TIMOTHY W	BENEDICTINE UNIVERSITY	Poster Presenter	Registered
MAROZ, ANDREJ	UNIVERSITY OF AUCKLAND	Poster Presenter	Registered
MARSALEK, ONDREJ	ACADEMY OF SCIENCES OF THE CZECH REPUBLIC	Speaker	Registered
MCLAIN, JASON L	GEORGIA INSTITUTE OF TECHNOLOGY	Poster Presenter	Registered
MILLIGAN, JAMIE	UNIVERSITY OF CALIFORNIA, SAN DIEGO	Discussion Leader	Registered
MITTAL, JAI PAL	BHABHA ATOMIC RESEARCH CENTER	Poster Presenter	Registered
MURNANE, MARGARET M	UNIVERSITY OF COLORADO	Speaker	Registered
MUSAT, RALUCA M	BROOKHAVEN NATIONAL LABORATORY	Poster Presenter	Registered
NELSON, WILLIAM H	GEORGIA STATE UNIVERSITY	Poster Presenter	Registered
NYGA, MALGORZATA M	INSTITUTE OF NUCLEAR CHEMISTRY AND TECHNOLOGY	Poster Presenter	Registered
OBERG, KARIN	HARVARD SMITHSONIAN	Speaker	Registered
OLANREWaju, BABAJIDE O	GEORGIA INSTITUTE OF TECHNOLOGY	Poster Presenter	Registered
ORLANDO, THOMAS M	GEORGIA INSTITUTE OF TECHNOLOGY	Chair	Registered
PARK, YEUNSOO	UNIVERSITY OF SHRBROOKE	Poster Presenter	Registered
PASTINA, BARBARA	SAANIO & RIEKKOLA	Speaker	Registered
PEOPLES, ANITA R	UNIVERSITY OF ROCHESTER	Poster Presenter	Registered
PIMBLOTT, SIMON M	UNIVERSITY OF MANCHESTER	Speaker	Registered
PORCEL, ERIKA P	UNIVERSITY PARIS SUD 11	Speaker	Registered
POSTON, MICHAEL J	GEORGIA INSTITUTE OF TECHNOLOGY	Poster Presenter	Registered
PRISE, KEVIN	QUEENS UNIVERSITY BELFAST	Speaker	Registered
RAUT, UJJWAL	UNIVERSITY OF VIRGINIA	Poster Presenter	Registered
REID, MIKE	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
RESCIGNO, THOMAS N	LAWRENCE BERKELEY NATIONAL LABORATORY	Speaker	Registered
RIMMER, DALE	BROOKHAVEN NATIONAL LAB	Attendee	Registered
ROSENBERG, RICHARD	ARGONNE NATIONAL LABORATORY	Speaker	Registered
ROTH, OLIVIA	UNIVERSITY OF NOTRE DAME	Poster Presenter	Registered
SAFFRE, DIMITRI	CEA SACLAY, FRANCE	Attendee	Registered
SCHMITZ, PAVLINA I	UNIVERSITY OF MANCHESTER	Poster Presenter	Registered
SEVILLA, MICHAEL D	OAKLAND UNIVERSITY	Discussion Leader	Registered
SHINDE, SUJATA S	UNIVERSITY OF AUCKLAND	Poster Presenter	Registered
SIEBBELES, LAURENS	DELFT UNIVERSITY OF TECHNOLOGY	Speaker	Registered

SMITH, DAVID Y	UNIVERSITY OF VERMONT & ARGONNE NAT'L LABORATORY	Poster Presenter	Registered
SOKOLOV, DENIS A	GEORGIA INSTITUTE OF TECHNOLOGY	Poster Presenter	Registered
STAEHLER, JULIA	FRITZ HABER INSTITUTE OF THE MAX PLANCK SOCIETY	Speaker	Registered
STANISKY, CHRISTOPHER M	NOTRE DAME RADIATION LABORATORY	Poster Presenter	Registered
TAGAWA, SEIICHI	OSAKA UNIVERSITY	Speaker	Registered
VALEEV, EDWARD	VIRGINIA TECH	Poster Presenter	Registered
WATSON, RICHARD M	UNIVERSITY OF ROCHESTER	Poster Presenter	Registered
WISHART, JAMES F	BROOKHAVEN NATIONAL LABORATORY	Speaker	Registered
WOJCIK, ALEKSANDRA	UNIVERSITY OF NOTRE DAME	Poster Presenter	Registered
WREN, JUNGSOOK CLARA	UNIVERSITY OF WESTERN ONTARIO	Poster Presenter	Registered
YAKABUSKIE, PAMELA A	UNIVERSITY OF WESTERN ONTARIO	Poster Presenter	Registered
YAMAMOTO, HIROKI	ISIR, OSAKA UNIVERSITY	Poster Presenter	Registered
YOSHIDA, YOICHI	ISIR, OSAKA UNIVERSITY	Poster Presenter	Registered
ZAGORSKI, ZBIGNIEW P	INSTITUTE OF NUCLEAR CHEMISTRY AND TECHNOLOGY	Poster Presenter	Registered

**100 Attendees**